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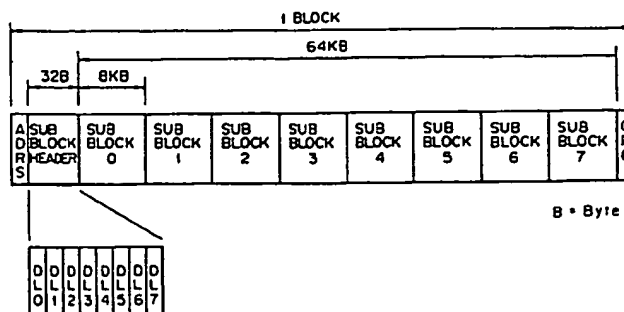
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(54) Recording medium and digital video-information recording/reproducing system.

(57) An information recording/reproducing system in which, at the time of information recording, an input digital video signal is divided into a plurality of frequency band components, and information portion data consisting of a predetermined number of sub-block data (subblock 0, subblock 1, etc) with each piece of the digital video signal data per frequency band taken as one subblock data and head portion data (DL0, DL1 etc) including identification data blocks indicating frequency bands for the respective

subblocks are recorded as one block on a recording medium. At the time of reproduction, individual pieces of identification data in a header portion are discriminated from the digital video signal, picked up from the recording medium, block by block, and the digital video signal of each subblock is selectively extracted in accordance with the identification data, and the bands of the extracted digital video signals are combined to thereby generate reproduced digital video signals.

Fig. 1**EP 0 558 853 A2**

The present invention relates to a recording medium on which a digital video signal is to be recorded, and a system for recording a digital video signal on this recording medium and reproducing the recorded video information possible.

In cases where video information is recorded on a recording medium such as a disk, in reproducing the video information, all the pieces of video signal data or recorded video information are normally reproduced to provide a video image having substantially the same image quality as the one at the time of recording the image. For instance, in playing a recording medium on which high-quality video information of the MUSE (Multiple Sub-Nyquist Sampling Encoding) system is recorded, the high-quality video information cannot be reproduced unless the recording medium is played by a machine which is specially designed for such a recording medium. When an operator wants to obtain high-quality video information at a low image quality, it is reproduced in the form of high-quality video information and is converted into a video image with the quality of, for example, an NTSC video image, by a separate down-converting machine.

The conventional conversion of the image quality is simply to convert the format of a video signal and cannot reproduce video information from a single recording medium with different image qualities and in the same video signal format.

It is therefore an object of the present invention to provide a recording medium which can allow video information to be reproduced with different image qualities in the same video signal format, and an information recording/reproducing system which can handle the same.

According to one aspect of the present invention, there is provided a recording medium on which a digital video signal is recorded in the form of blocks, each block comprising an information portion consisting of a plurality of subblocks, and a header portion including a plurality of identification data blocks located preceding the information portion and respectively associated with said subblocks, each identification data block indicating a frequency band of the recorded digital video signal in the associated one of the subblocks.

On the recording medium embodying the present invention, a plurality of subblocks in each of which a digital video signal is to be recorded are formed in each block, and identification data indicating the frequency bands of the digital video signals of the respective subblocks are respectively recorded in a plurality of identification data blocks, which are located preceding the subblocks in one block and respectively associated with the subblocks.

According to another aspect of the present invention, there is provided an information recording system for recording a digital video signal on a recording medium, comprising means for dividing an input digital video signal into a plurality of frequency band components and generating a group of band digital video signal data; means for producing information portion data consisting of a predetermined number of subblock data with each piece of the band digital video signal data per frequency band taken as one subblock data; means for producing header portion data including identification data blocks indicating frequency bands respectively associated with the subblocks; and means for recording the information portion data and the header portion data as one block on said recording medium.

In the information recording system embodying the present invention, an input digital video signal is divided into a plurality of frequency band components to be a group of band digital video signal data, information portion data consisting of a predetermined number of subblock data with each piece of the band digital video signal data per frequency band taken as one subblock data and header portion data including identification data blocks indicating frequency bands for the respective subblocks are produced, and the information portion data and the header portion data are recorded as one block on the recording medium.

According to a further aspect of the present invention, there is provided an information reproducing system for a recording medium on which a digital video signal has been recorded in the form of blocks, each block comprising an information portion consisting of a plurality of subblocks, and a header portion including a plurality of identification data blocks located preceding the information portion and respectively associated with the subblocks, each identification data block indicating the frequency band of the recorded digital video signal in the associated one of the subblocks, the system comprising reading means for reading the digital video signal from the recording medium; identifying and selecting means for acquiring, block by block, identification data in the header portion from the digital video signal output from the reading means and selectively relaying the digital video signals of the subblocks in accordance with the identification data; and means for, every time digital video signals for a predetermined number of subblocks are relayed from the identifying and selecting means, performing band combination of the relayed digital video signals to thereby generate reproduced digital video signals.

In the information reproducing system embodying the present invention, individual pieces of identification data in the header portion are discrimi-

nated from the digital video signal, read out from a recording medium by the reading means and output therefrom, block by block, and the digital video signal of each subblock is selectively relayed from the identifying and selecting means in accordance with the identification data, and, every time digital video signals for a predetermined number of subblocks are relayed from the identifying and selecting means, the bands of the relayed digital video signals are combined to thereby generate reproduced digital video signals.

According to a yet further aspect of the present invention, there is provided an information recording/reproducing system for recording a digital video signal on a recording medium and reproducing the digital video signal therefrom, comprising: means for dividing an input digital video signal into a plurality of frequency band components and generating a group of band digital video signal data; means for producing information portion data consisting of a predetermined number of subblock data with each piece of said band digital video signal data per frequency band taken as one subblock data; means for producing header portion data including identification data blocks indicating the frequency bands respectively associated with said subblocks; means for recording said information portion data and said header portion data as one block on said recording medium; reading means for reading said digital video signal from said recording medium; identifying and selecting means for acquiring, block by block, identification data in said header portion from said digital video signal output from said reading means and selectively relaying said digital video signals of said subblocks in accordance with said identification data; and means for, every time digital video signals for a predetermined number of subblocks are relayed from said identifying and selecting means, performing band combination of said relayed video digital signals to thereby generate reproduced digital video signals.

A preferred embodiment of the present invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Fig. 1 is a diagram illustrating the physical format of one block of a recording medium according to the present invention;

Fig. 2 is a diagram exemplifying the arrangement of subblocks of an audio signal and a video signal on the recording medium embodying the present invention;

Fig. 3 is a block diagram illustrating the structure of an information recording system according to the present invention;

Fig. 4 is a diagram showing effective pixels in one frame;

Fig. 5 is a diagram showing the states before and after DCT transform;

Fig. 6 is a diagram illustrating the results of DCT transform in a two-dimensional frequency plane;

Fig. 7 is a block diagram illustrating the structure of an information reproducing system according to the present invention; and

Fig. 8 is a diagram illustrating frame data before DCT transform in a two-dimensional frequency plane.

Fig. 1 illustrates the structure of one block of a recording medium embodying the present invention. One block consists of an address (ADRS), a subblock header (SUBBLOCK HEADER), eight subblocks (SUBBLOCK) 0 to 7 and an error detection code (CRC: Cyclic Redundancy Check). The address, the foremost element of one block, indicates the position of that block on a track. The subblock header following the address consists of 32 bytes and indicates the types of information signals of the subblocks. The subblock header is therefore divided into eight areas where device labels (DL0 to DL7) as identification data indicating the types of the information signals of the associated subblocks are to be respectively described. The eight subblocks 0 to 7 follow the subblock header in order. The error detection code is located at the end of the block.

On the recording medium, blocks each having such a structure are repeatedly located in the order of their addresses along the track, with a sync signal (not shown in Fig. 1) inserted between consecutive blocks.

Given that the capacity of one subblock is 8 Kbytes, the total capacity of the eight subblocks 0 to 7 becomes 64 Kbytes, as shown in Fig. 1, and the capacity of the subblock header is 32 bytes.

Each of the eight device labels (DL0 to DL7) defines a maximum of 256 types of devices with values of 00H to FFH (H indicates a hexadecimal notation). 00H to FFH may be previously determined as follows.

00H: NULL
01H: SYSTEM 02H-0FH: RESERVED
10H-13H: VIDEO CH1-CH4 14H-1FH: RESERVED
20H-23H: AUDIO CH1-CH4 24H-FFH: RESERVED
NULL represents that the device has no significant meaning and is used when a dummy is necessary in video signal data and audio signal data; the system need not read data from the associated subblock, thus ensuring an efficient operation. SYSTEM stores a control program or the like which is used by the system. VIDEO is video signal data, and AUDIO audio signal data. CH1 to CH4 indicate channel numbers, and RESERVED indicates that the associated subblock is reserved for an information signal which will be set in the future. If the device label DL0 is set as DL0: DEVICE LABEL =

10H, the information signal in the subblock 0 is video signal data of the first channel. With DL1: DEVICE LABEL = 21H, the information signal in the subblock 1 is audio signal data of the second channel.

When an optical disk which can be played at the transfer rate of 4.7 Mbps is used as a recording medium, the digital reproduced signal is output at the rate of nine blocks per sec or 72 subblocks per sec. If 4-channel audio signal data and 4-channel video signal data are allocated on the optical disk, the subblocks would be arranged as shown in Fig. 2. This arrangement is the format in which audio signal data for four channels are assigned to a half of one block with one subblock provided per channel, and video signal data for four channels are assigned to the subsequent 32 subblocks in that block with eight subblocks per channel. In this case, a group of information signals including audio signal data and video signal data both for four channels are repeated in a cycle of 36 subblocks. It is to be noted that the video signal data for four channels is one video image divided into four as will be described later, not four video images assigned as video signal data to the individual channels. The audio signal data for four channels are sounds of independent channels, respectively.

A description will now be given of an information recording system which records audio signal data and video signal data in such a format on a disk.

In the information recording system, 1-channel input digital video signal data is supplied to a video compressing/coding section 1. The video compressing/coding section 1 comprises a sub-sampling circuit 2, an MC + DPCM (DPCM between movement compensation frames) circuit 3, an inter-frame DCT (Discrete Cosine Transform) circuit 4, a selector 5, quantizers 6A to 6D and Huffman coders 7A to 7D. The sub-sampling circuit 2 thins out the input video signal data at a sub-sampling frequency which is, for example, a half the sampling frequency, and outputs the resultant data. The video signal data from the sub-sampling circuit 2 is supplied via the MC + DPCM circuit 3 to the DCT circuit 4. The DCT circuit 4 divides the video signal data into blocks of 8×8 pixels, and performs two-dimensional DCT transform for each block. The output of the DCT circuit 4 is connected to the selector 5, which divides the result of the DCT transform into four and distributes the resultant data. The distribution outputs of the selector 5 are connected to the quantizers 6A-6D to which the Huffman coders 7A to 7D are also connected. The video coded data output from the Huffman coders 7A to 7D are held in buffers 8A to 8D, respectively.

Meantime, the digital audio signal data for four channels are respectively supplied to subband cod-

ing sections 11A to 11D. The subband coding section 11A comprises a subband dividing filter 41, a quantizer 42, an FFT analyzer 43 and a multiplexer 44. The subband dividing filter 41 divides the digital audio signal data into a plurality of bands, for example, 32 bands, and outputs the resultant data to the quantizer 42 in the order of a lower frequency band. The FFT analyzer 43 prepares coding data from the audio signal data to determine the number of quantizing bits of each band in the quantizer 42. The quantized data output from the quantizer 42 is supplied together with the coding data to the multiplexer 44 where they are formed into audio coded data in a predetermined format. The subband coding sections 11B to 11D are designed in the same manner as the subband coding section 11A. The audio coded data output from the subband coding sections 11A to 11D are held in buffers 12A to 12D, respectively.

The outputs of the buffers 8A to 8D and 12A to 12D are connected to a selector 13 to which an address subblock header data generator 14 is connected. The selector 13 combines the individual pieces of data held in the buffers 8A to 8D and 12A to 12D with the address subblock header data from the address subblock header data generator 14 to prepare subblocked data, and supplies the sub-block data to a correction code adding circuit 15. The output of the correction code adding circuit 15 is connected to a modulator 16 whose output signal is supplied via a driver 17 to a recording head 18. A disk 19 on which the video signal data and audio signal data are to be recorded is rotated by a well-known disk driving system (not shown).

In the thus constituted information recording system, digital video signal data in use is $Y C_R C_B$ data which is acquired by converting three-color data, RGB (red, green, blue), into a luminance signal component Y and two color difference signal components C_R and C_B . This is a format standardized in Rec. 601 of CCIR (International Radio Consultative Committee). As individual pieces of YUV data are compressed and coded in the aforementioned manner by the above structure, a description will be given only on the luminance signal component Y.

The number of pixels in one frame of the luminance signal component Y after sub-sampling is 858 (horizontal direction) \times 525 (vertical direction) as shown in Fig. 4(a). The number of effective pixels in the total pixels is 720×480 . The 720×480 pixels are coded in the movement compensation predicting system in the MC + DPCM circuit 3, and then divided by the DCT circuit 4 into blocks each consisting of 8×8 pixels, as shown in Fig. 4(b). One frame contains $90 \times 60 = 5400$ divided blocks. The DCT transform is carried out for each block consisting of 8×8 pixels. Provided that the

block A in Fig. 4(b) has pixel data Y_{ij} ($i = 0, 1, \dots, 7, j = 0, 1, \dots, 7$) of the luminance signal component as shown in Fig. 5(a), the DCT transform of the one block yields DCT transformed data D_k ($k = 1, 2, \dots, 64$) as shown in Fig. 5(b). The closer the position of the DCT transformed data D_k to the upper left, then that DCT transformed data D_k represents a lower frequency component. The result of the DCT transform can be viewed as a two-dimensional frequency plane as shown in Fig. 6. The smaller the value of k in the DCT transformed data D_k is, the lower the frequency of that data becomes. The selector 5 thus divides the DCT transformed data D_k into four areas 1 to 4 with different frequency bands and distributes the data accordingly. For instance, D_1 to D_6 are allocated in the area 1, D_7 to D_{15} in the area 2, D_{16} to D_{36} in the area 3 and D_{37} to D_{64} in the area 4, as indicated by the thick solid lines in Fig. 6. The data in the area 1 is supplied to the quantizer 6A, the data in the area 2 to the quantizer 6B, the data in the area 3 to the quantizer 6C, and the data in the area 4 to the quantizer 6D. The quantizers 6A to 6D linearly quantize the respective pieces of data in the assigned step sizes using quantizing tables. The quantized pieces of data are transformed into Huffman codes in the Huffman coders 7A to 7D before they are held in the buffers 8A to 8D.

The 4-channel audio signal data is also coded and held in the respective buffers 12A to 12D. To divide the data held in the buffers 8A to 8D and 12A to 12D, therefore, the selector 13 outputs the address data from the address subblock header data generator 14 first, and then outputs the subblock header data. The subblock header data, which serves to determine device labels (DL0-DL7), is set previously. After outputting the subblock header data, the selector 13 outputs the audio signal data of the first channel from the buffer 12A as subblock data A1, the audio signal data of the second channel from the buffer 12B as subblock data A2, the audio signal data of the third channel from the buffer 12C as subblock data A3, and the audio signal data of the fourth channel from the buffer 12D as subblock data A4, in order. Further, the selector 13 sequentially outputs the video signal data of the area 1 from the buffer 8A as subblock data V1, the video signal data of the area 2 from the buffer 8B as subblock data V2, the video signal data of the area 3 from the buffer 8C as subblock data V3, and the video signal data of the area 4 from the buffer 8D as subblock data V4. In other words, the selector 13 outputs the subblock data as indicated by "13a" in Fig. 3. It should be noted that one subblock data is not limited to one subblock, but may span over a plurality of subblocks. The subblocked data signals for each block are supplied to the correction code adding

circuit 15 where an error correction code ECC is added for each subblock data as shown by "15a" in Fig. 3. The output signal of the correction code adding circuit 15 is modulated by a modulation system, such as EFM modulation, by the modulator 16. The output signal of the modulator 16 is supplied via the driver 17 to the recording head 18 to be written on the disk 19. If the recording head 18 is of an optical type that uses a semiconductor laser, the video and audio information are recorded on the disk 19 by the irradiated laser beam.

Fig. 7 illustrates a system for reproducing information from a disk on which digital video signal data and audio signal data are recorded. This information reproducing system does not reproduce all the recorded video signal data, but reproduces only the video signal data in the areas 1 and 2. The arrangement of the reproducing system will be described below. A disk 20 is driven by a driving system (not shown), and a pickup head 21 optically picks up the recorded contents from the disk 20. The picked-up RF signal output from the pickup head 21 is supplied to a demodulator 22 where it is demodulated into a digital signal block by block by a demodulating system, such as EFM demodulation. In other words, the demodulator 22 outputs the individual pieces of data in the order of subblocks indicated by "22a" in Fig. 7. The demodulator 22 is connected via an error correcting circuit 23 to a subblock identifying circuit 24.

The error correcting circuit 23 performs error correction only on subblock data V1 and V2 of the video signal data as indicated by "23a" in Fig. 7, and will not output subblock data V3 and V4, disregarding them. The subblock identifying circuit 24 identifies the contents of the individual device labels (DL0-DL7) in the subblock header for each block using, for example, a table and distributes the subblocks at the timing according to the sync signal. The subblock identifying circuit 24 is provided with distribution output terminals, which include audio outputs A1 to A4, and video outputs V1 and V2. When the subblock identifying circuit 24 identifies the digital signal from the error correcting circuit 23 and when the content of the identified device label is DL0: DEVICE LABEL = 20H, the digital signal in the subblock 0 is supplied as a digital audio signal of the first channel from the audio output A1. When the content of the identified device label is DL1: DEVICE LABEL = 21H, the digital signal in the subblock 0 is supplied as a digital audio signal of the second channel from the audio output A2. The same is applied to the subblocks 2 and 3. When the content of the identified device label is DL4: DEVICE LABEL = 10H, the digital signal in the subblock 4 is output as a digital video signal of the first channel (area 1) from the video output V1. With DL5: DEVICE LABEL = 11H,

the digital signal in the subblock 5 is output as a digital video signal of the second channel (area 2) from the video output V2.

Some modification may be made so that the error correcting circuit 23 performs error correction on all the subblock data V1 to V4 of the video signal data while the subblock identifying circuit 24 outputs only the subblock data V1 and V2 of the video signal data after the error correction in accordance with the content of the identified device label.

The audio outputs A1 to A4 are connected via buffers 25A to 25D to subband decoding sections 26A to 26D, respectively. The subband decoding section 26A comprises a format selector 27, an inverse quantizer 28, a decode data discriminator 29 and a multiplier 30. The format selector 27 selects the audio signal component data and the decode data from the digital audio signal data held in the buffer 25A and outputs those data. The selected decode data is supplied to the decode data discriminator 29, which discriminates the number of quantizing bits at the time of the data coding and to which subband the data belongs, on the basis of the decode data. The inverse quantizer 28 performs inverse quantization of the audio signal component data in accordance with the output signal of the decode data discriminator 29 for each subband to decode the original amplitude level to data and sends the resultant data to the multiplier 30. The multiplier 30 combines the decoded data of the individual subbands to transform it into a full-band audio decoded data in accordance with the output signal of the decode data discriminator 29. The subband decoding sections 26B to 26D are designed in the same way as the subband decoding section 26A. The audio decoded data output from each of the subband decoding sections 26A to 26D is a digital audio reproduced signal.

The video outputs V1 and V2 are connected via buffers 31A and 31B to a video expanding/decoding section 32. The video expanding/decoding section 32 comprises Huffman decoders 33A and 33B, inverse quantizers 34A and 34B, a combining circuit 35, an inter-frame inverse DCT circuit 36, an inverse MC+DPCM circuit 37 and a sub-sampling interpolating circuit 38. The video expanding/decoding section 32 performs an operation reverse to that of the aforementioned compressing/coding section 1.

The digital video signal data output from the video output V1 is held in the buffer 31A. The digital video signal data is supplied to the inverse quantizer 34A after being decoded by the Huffman decoder 33A. The inverse quantizer 34A performs inverse quantization of the decoded video signal data using a quantizing table. The digital video signal data output from the video output V2 is

likewise processed by the Huffman decoder 33B and the inverse quantizer 34B. The individual pieces of inverse-quantized video signal data are arranged in the order of areas 1 and 2 in the combining circuit 35 to become block-by-block data. The data for one frame, when expressed in a two-dimensional frequency plane, becomes as shown in Fig. 8; only the areas 1 and 2 contain data while the areas 3 and 4 contain no data so that data becomes all zero. The output signal of the combining circuit 35 is subjected to inverse DCT transform in the inter-frame inverse DCT circuit 36 for each block consisting of 8×8 pixels. The resultant signal is then supplied to the inverse MC+DPCM circuit 37. The inverse MC+DPCM circuit 37 decodes the data undergone the inverse DCT transform, in the movement compensation predicting system, yielding video signal data consisting of 720×480 pixels. This video signal data is interpolated by the sub-sampling interpolating circuit 38, and the resultant signal is output as a reproduced digital video signal.

Although the video signal data of only the areas 1 and 2 are reproduced in the above-described embodiment, the present invention is not restricted to the particular type. For example, if the video signal data are written in all the areas 1 to 4, the video signal data of all the areas 1 to 4 may of course be reproduced, or if the video signal data are written in the areas 1 to 3, the video signal data of the areas 1 to 3 may be reproduced. A switch may be provided to select from which one of the areas 1-4 data should be reproduced, so that data of the selected area alone can be reproduced according to the selection.

Further, the arrangement for separating the digital video signal into a plurality of frequency bands is not limited to the one described above. For instance, a plurality of BPFs may be used to divide the digital video signal.

Further, although the recording medium has been described as a disk in the foregoing description, it is in no way limited to this particular type, but the present invention may be adapted for other types of recording media such as a tape and a card.

In short, according to the present invention, at the time information is recorded on a recording medium, an input digital video signal is divided into a plurality of frequency band components to be a group of band digital video signal data, information portion data consisting of a predetermined number of subblock data with each piece of the band digital video signal data per frequency band taken as one subblock data and header portion data including identification data blocks indicating frequency bands for the respective subblocks are produced, and the information portion data and the header

portion data are recorded as one block on the recording medium. At the time information is reproduced from the recording medium, individual pieces of identification data in the header portion are discriminated from the digital video signal, read out from the recording medium, block by block, and the digital video signal of each subblock is extracted in accordance with the identification data, and, every time digital video signals for a predetermined number of subblocks are extracted, the bands of the extracted digital video signals are combined to thereby generate reproduced digital video signals.

At the reproduction time, therefore, video information can be reproduced from the same recording medium with the image quality determined by the specification of the reproducing system or an arbitrary image quality and in the same video signal format. If the reproducing system is used to see pictures, for example, a high-image quality specification to reproduce the full band of the recorded digital video signal should be used. With the reproducing system used for news reports, a low-image quality specification to reproduce a partial band of the recorded digital video signal may be used. In this manner, the reproducing system can be selected according to the purpose of the usage. The present invention is therefore advantageous in permitting a user to select a low-cost reproducing system with a low-image quality specification rather than an expensive reproducing system with a high-image quality specification when the latter is not particularly needed.

Claims

1. A recording medium on which a digital video signal is recorded in the form of blocks, each block comprising an information portion consisting of a plurality of subblocks, and a header portion including a plurality of identification data blocks located preceding said information portion and respectively associated with said subblocks, each identification data block indicating the frequency band of said recorded digital video signal in the associated one of said subblocks.
2. An information recording system for recording a digital video signal on a recording medium (19), comprising:
 - means (1) for dividing an input digital video signal into a plurality of frequency band components and generating a group of band digital video signal data;
 - means (13) for producing information portion data consisting of a predetermined number of subblock data with each piece of said

band digital video signal data per frequency band taken as one subblock data;

means (14) for producing header portion data including identification data blocks indicating the frequency bands respectively associated with said subblocks; and

means (18) for recording said information portion data and said header portion data as one block on said recording medium (19).

3. An information reproducing system for a recording medium (20) on which a digital video signal has been recorded in the form of blocks, each block comprising an information portion consisting of a plurality of subblocks, and a header portion including a plurality of identification data blocks located preceding the information portion and respectively associated with the subblocks, each identification data block indicating the frequency band of the recorded digital video signal in the associated one of the subblocks, the system comprising:

reading means (21) for reading said digital video signal from said recording medium;

identifying and selecting means (24) for acquiring, block by block, identification data in said header portion from said digital video signal output from said reading means (21) and selectively relaying said digital video signals of said subblocks in accordance with said identification data; and

means (22) for, every time digital video signals for a predetermined number of subblocks are relayed from said identifying and selecting means, performing band combination of said relayed digital video signals to thereby generate reproduced digital video signals.

4. An information recording/reproducing system for recording a digital video signal on a recording medium (19,20) and reproducing the digital video signal therefrom, comprising:

means (1) for dividing an input digital video signal into a plurality of frequency band components and generating a group of band digital video signal data;

means (13) for producing information portion data consisting of a predetermined number of subblock data with each piece of said band digital video signal data per frequency band taken as one subblock data;

means (14) for producing header portion data including identification data blocks indicating the frequency bands respectively associated with said subblocks;

means (18) for recording said information portion data and said header portion data as one block on said recording medium;

reading means (21) for reading said digital video signal from said recording medium;

identifying and selecting means (24) for acquiring, block by block, identification data in said header portion from said digital video signal output from said reading means and selectively relaying said digital video signals of said subblocks in accordance with said identification data; and

means (32) for, every time digital video signals for a predetermined number of subblocks are relayed from said identifying and selecting means, performing band combination of said relayed digital video signals to thereby generate reproduced digital video signals.

5. A recording system as claimed in claim 2, wherein the means (1) for dividing the input digital video signal into a plurality of frequency band components comprises:

means (4) to convert the input digital video signal data into a plurality of blocks, each block comprising a plurality of pixels, and to transform the data in each block, whereby pixels of transformed data having similar frequencies are located in proximity to one another in the transformed block;

and

means (5) to divide the transformed block into regions with different frequencies such that the input digital video signal is divided in a plurality of frequency band components.

6. A reproducing system as claimed in claim 3, wherein said means (32) for performing band combination of said relayed digital video signals comprises:

means to combine the relayed digital video signals to form blocks of data comprising a plurality of pixels, in which pixels of data having similar frequencies are located in proximity to one another in a block; and

means (36) to transform the data in each block to generate reproduced digital video signals.

7. A recording/reproducing system as claimed in claim 4, wherein the means (1) for dividing the input digital video signal into a plurality of frequency band components comprises:

means (4) to convert the input digital video signal data into a plurality of blocks, each block comprising a plurality of pixels, and to transform the data in each block, whereby pixels of transformed data having similar frequencies are located in proximity to one another in the transformed block;

and

means (5) to divide the transformed block into regions with different frequencies such that the input digital video signal is divided in a plurality of frequency band components; and

said means (32) for performing band combination of said relayed digital video signals comprises:

means to combine the relayed digital video signals to form blocks of data comprising a plurality of pixels, in which pixels of data having similar frequencies are located in proximity to one another in a block; and

means (36) to transform the data in each block to generate reproduced digital video signals.

Fig. 1

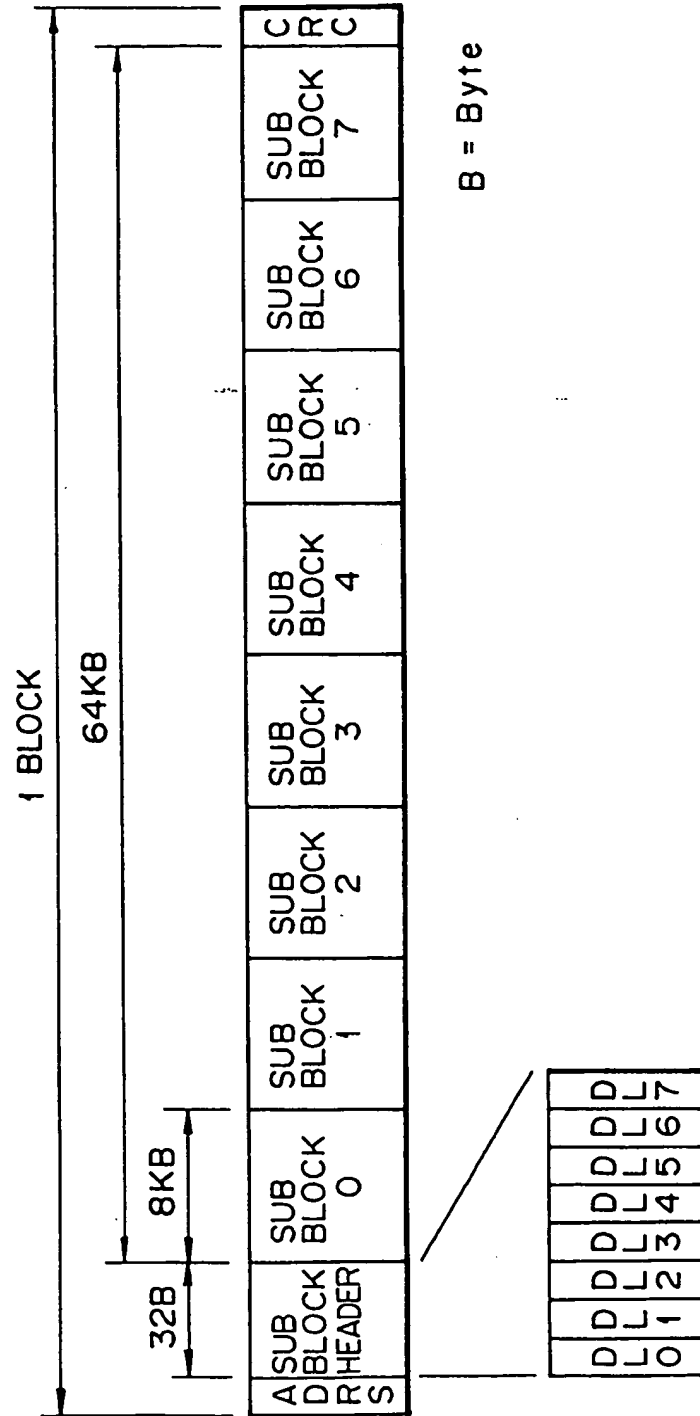


Fig. 2

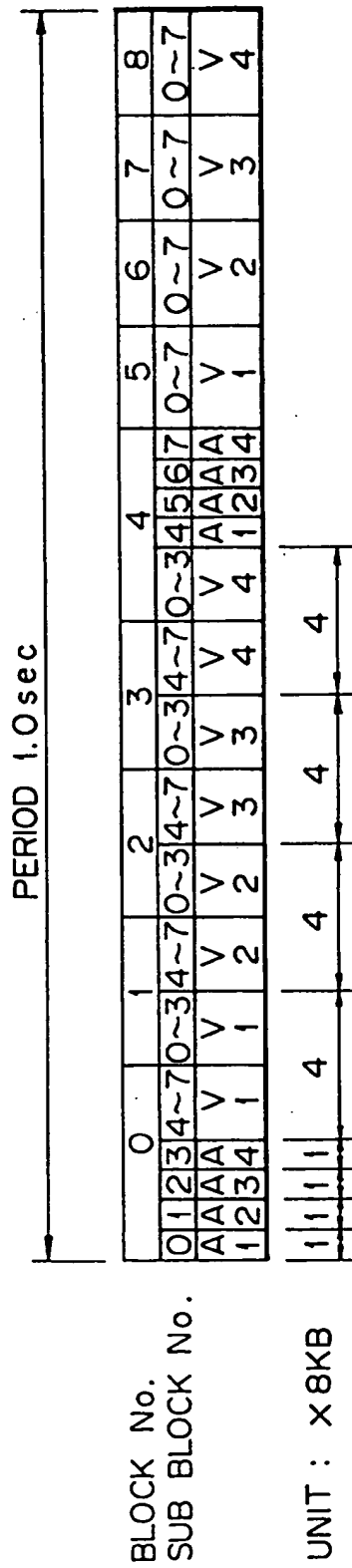


Fig. 3

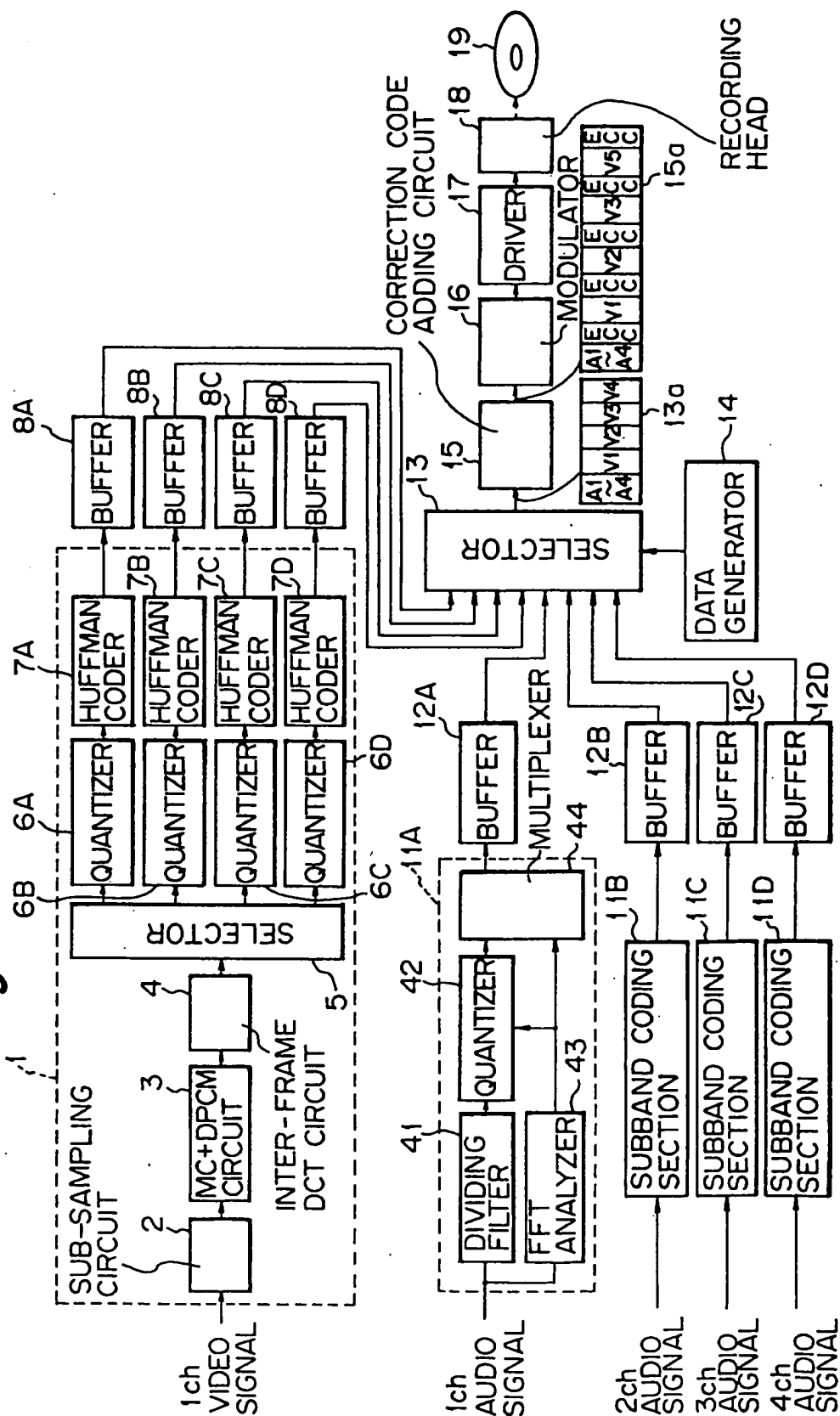


Fig. 4(b)

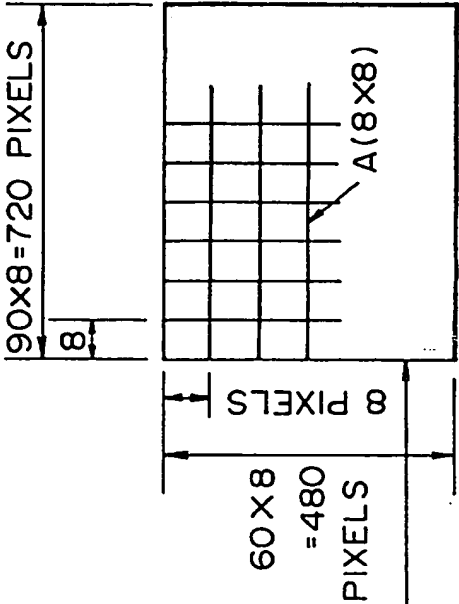


Fig. 4(a)

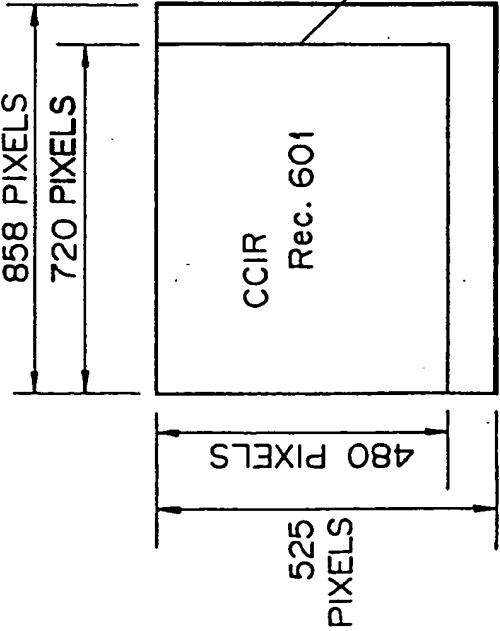


Fig. 5(a)

A →

Y00	Y01	Y02	Y03	Y04	Y05	Y06	Y07
Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17
Y20	Y21	Y22	Y23	Y24	Y25	Y26	Y27
Y30	Y31	Y32	Y33	Y34	Y35	Y36	Y37
Y40	Y41	Y42	Y43	Y44	Y45	Y46	Y47
Y50	Y51	Y52	Y53	Y54	Y55	Y56	Y57
Y60	Y61	Y62	Y63	Y64	Y65	Y66	Y67
Y70	Y71	Y72	Y73	Y74	Y75	Y76	Y77

Fig. 5(b)

D1	D2	D6	D7	D15	D16	D28	D29
D3	D5	D8	D14	D17	D27	D30	D43
D4	D9	D13	D18	D26	D31	D42	D44
D10	D12	D19	D25	D32	D41	D45	D54
D11	D20	D24	D33	D40	D46	D53	D55
D21	D23	D34	D39	D47	D52	D56	D61
D22	D35	D38	D48	D51	D57	D60	D62
D36	D37	D49	D50	D58	D59	D63	D64

Fig. 6

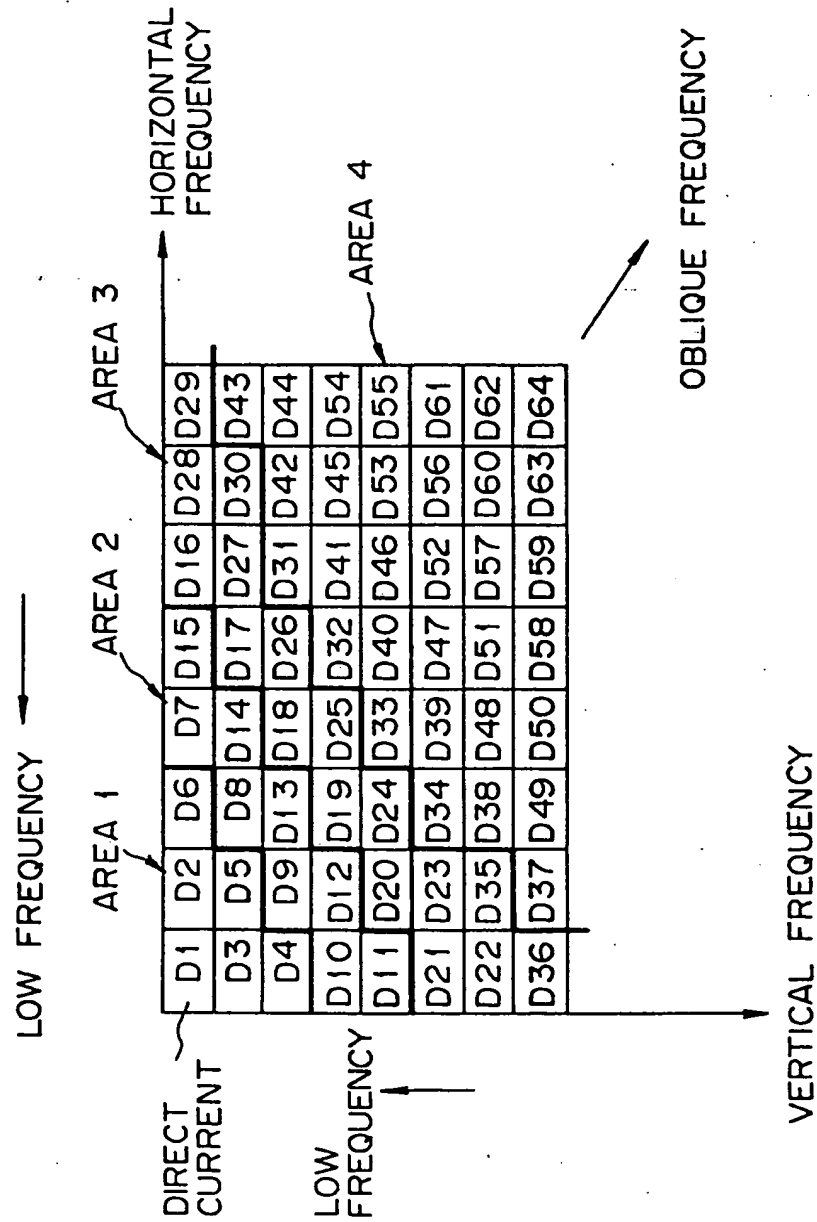


Fig. 7

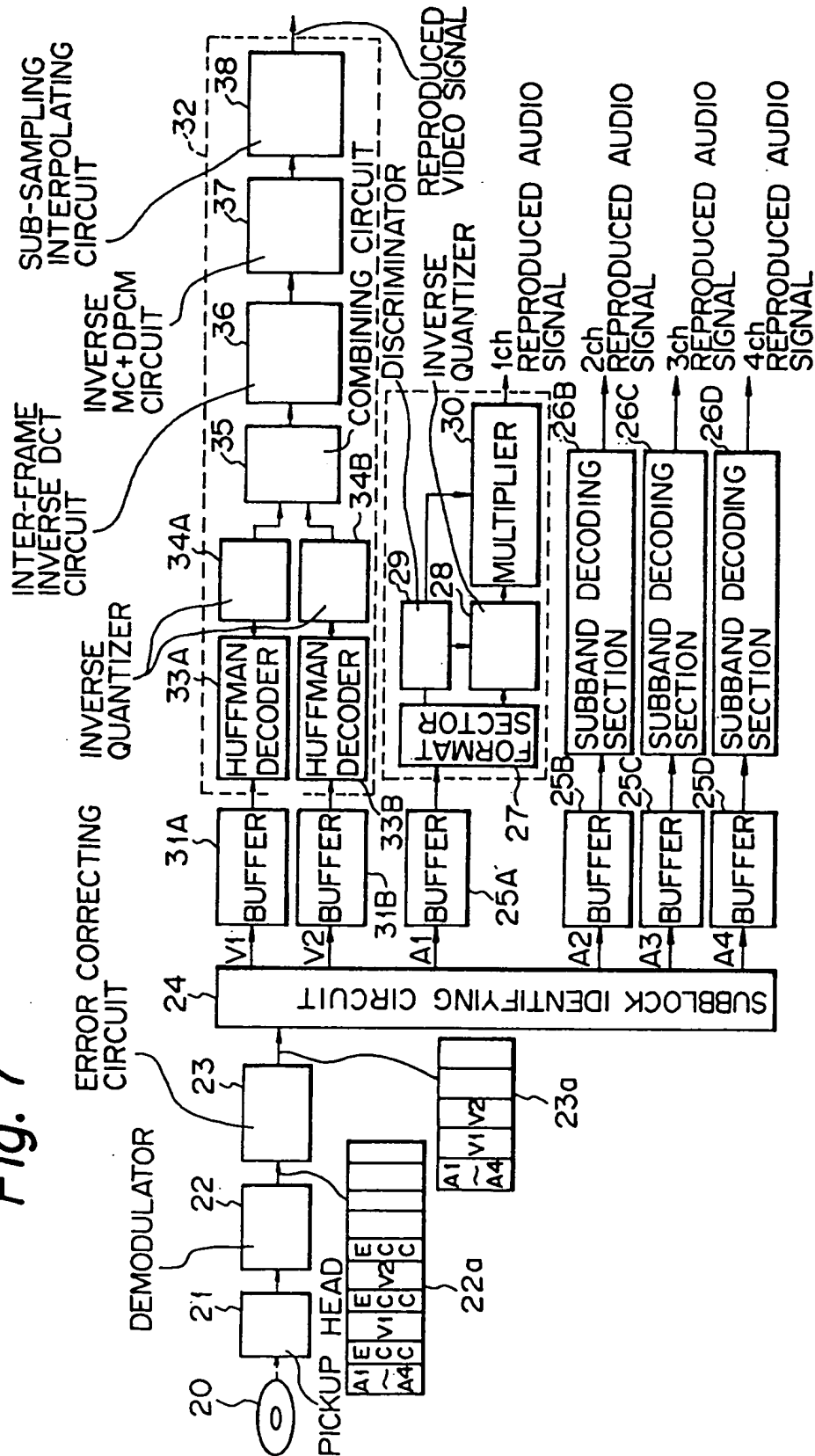
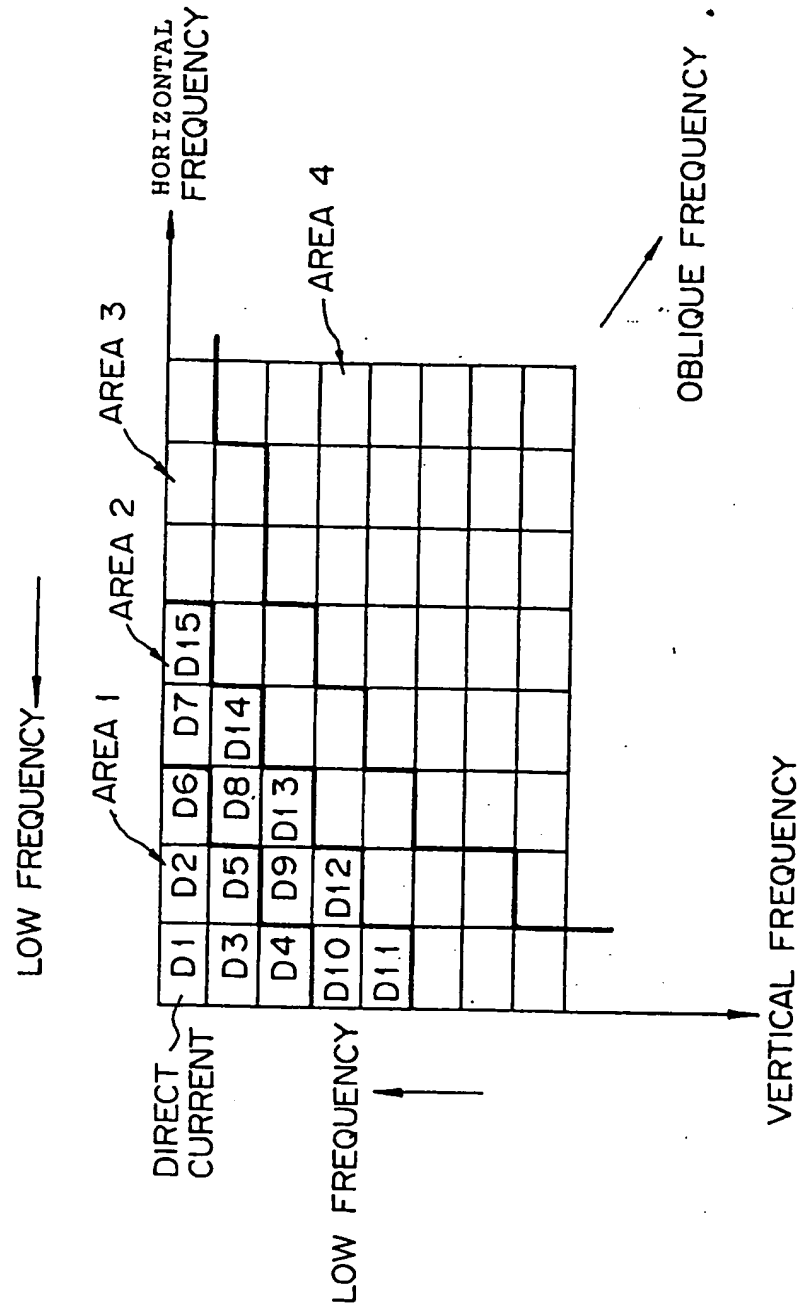


Fig. 8





PATENT ABSTRACTS OF JAPAN

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(71) Applicant: VICTOR CO OF JAPAN LTD

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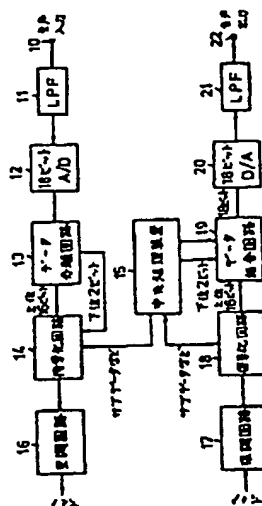
(54) SOUND DATA RECORDING AND REPRODUCING DEVICE

(57) Abstract:

PURPOSE: To reduce quantized noises so as to improve the quality of sound data by recording analog sound signals in different areas of the track of a magnetic tape after converting the signals into sound data having (n) bits of quantized bits and dividing the quantized bits into higher-rank (m) bits and lower-rank (n-m) bits and coupling and D/A converting the sound data at the time of reproduction.

CONSTITUTION: Analog sound signals at an input terminal 10 are quantized to 18 bits quantized bits by means of an 18-bit A/D converter 12. Then each 18 bits are separated into higher-rank 16 bits and lower-rank 2 bits by means of a data separation circuit 13 and the higher-rank 16 bits are supplied as sound data to an encoding circuit 14. The lower-rank 2 bits are also supplied to the circuit 14 as sub-code data together with sub-code signals from a CPU. The circuit 14 records these data in the sound data and sub-code areas of a magnetic tape as one block through a modulator circuit 16. At the time of reproduction, the higher- and lower-rank bits are coupled together by means of a data coupling circuit 19 after the bits are respectively decoded and outputted as 18 bits after D/A conversion. Therefore, quantization noises are reduced.

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⑮ 発明の名称 音声データ記録再生装置

⑯ 特 願 昭63-172299

⑰ 出 願 昭63(1988)7月11日

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明 細 書

1. 発明の名称

音声データ記録再生装置

2. 特許請求の範囲

アナログ音声信号を量子化ビット数 n ビット(ただし、 n は3以上の整数)の音声データに変換して出力する n ビットA/D変換器と、

前記量子化ビット数 n ビットの音声データの夫々を上位 m ビット(ただし、 m は2以上の整数で、 $m < n$)と下位 $(n-m)$ ビットとに夫々分離するデータ分離回路と、

量子化ビット数 m ビットの音声データを磁気テープ上のトラックの第1の領域に記録し、サブコード信号を同じトラックの別の第2の領域に記録する既存の音声データ記録再生装置と同様に上記第1の領域に上記分離された上位 m ビットの各データを記録し、かつ、上記第2の領域に上記分離された下位 $(n-m)$ ビットの各データと該下位 $(n-m)$ ビットの各データが該第2の領域に記録されていることを示す識別情報とを夫々記録す

る記録手段とを記録系に具備し、

上記第1及び第2の領域に記録された各信号を夫々再生する再生手段と、

上記再生手段よりの再生信号中の前記識別情報に基づき、前記第1の領域から再生された前記上位 m ビットの各データに前記第2の領域から再生された前記下位 $(n-m)$ ビットの各データを結合して量子化ビット数 n ビットの音声データを得る動作を行なうデータ結合回路と、

上記データ結合回路から取り出された上記量子化ビット数 n ビットの音声データをアナログ音声信号に変換する n ビットD/A変換器とを再生系に具備することを特徴とする音声データ記録再生装置。

3. 発明の詳細な説明

産業上の利用分野

本発明は音声データ記録再生装置に係り、特に音声データと他のディジタル情報信号とを同じトラックの別々の領域に記録し、それを再生する音声データ記録再生装置に関する。

従来の技術

アナログオーディオ信号をパルス符号変調 (PCM) して得られた PCM 音声データを同期信号や ID コード、アドレス、パリティなどに時分割多重してなるブロック単位で合成し、これに音声データ以外のデジタル情報信号などからなるサブコード信号やトラッキング信号を更に時分割多重して得た信号を回転ヘッドにより磁気テープ上に記録し、これを再生するデジタル・オーディオ・テープレコーダ (以下、「DAT」と記す) が知られている。

第3図はこのDATにより記録形成された1本のトラックの構成を示す。同図中、磁気テープ上に回転ヘッドにより記録された1本のトラック2は回転ヘッドの走査方向に、サブコード領域3a、ATF領域4a、PCM領域5、ATF領域4b、サブコード領域3bの順に配置され、かつ、各領域間にはインターブロックギャップ (IBG) が設けられている。サブコード領域3a、3bは夫々8ブロック、トラッキング信号が記録

されているATF領域4a、4bは各々5ブロック、PCM領域5は128ブロックで、1本のトラックは196ブロックから構成されている。

PCM領域5を構成する128ブロックの各々は第4図に示す如く、8ビットの同期信号、各8ビットの信号W1、W2、パリティ、そして全部で256ビット (= 32シンボル) のPCM音声データ及びパリティが時系列的に合成されている。また、W1は主としてフォーマットIDやフレームアドレスを示すIDコードであり、W2は1本のトラックのPCM領域5の例ブロック目であることを示すブロックアドレスである。

また、サブコード領域3a、3bを構成する全部で16ブロックの各々は第5図に示す如く、各8ビットの同期信号、SW1、SW2及びパリティと256ビットのサブコードデータ及びそのパリティとが時系列的に合成された信号フォーマットとされており、1ブロックのビット数は上記PCM領域5のブロックと同一である。なお、第5図においてSW1は主としてデータIDやプログラ

ムナンバーで、またSW2はサブコードIDとブロックアドレスとからなる。

かかる信号フォーマットのトラックを順次に形成するDATにおいて、PCM音声データは2チャンネル (ch) のアナログ音声信号を48kHzで標本化し、それを量子化ビット数16ビットで直線量子化したものが標準モードとして定められているが、これ以外にも標本化周波数44.1kHzで16ビット直線量子化2ch、標本化周波数32kHzで18ビット直線量子化2ch、標本化周波数32kHzで12ビット折線量子化2ch、標本化周波数32kHzで12ビット折線量子化4chの各モードが定められている。

発明が解決しようとする課題

しかるに、従来は量子化ビット数が最高でも16ビット直線量子化までしかなく、より量子化ノイズの少ない高品質の音声データの記録再生ができなかった。

本発明は上記の点に鑑みてなされたもので、既存の装置による互換再生を確保しつつ、より高品質な再生ができる音声データ記録再生装置を提供することを目的とする。

質な再生ができる音声データ記録再生装置を提供することを目的とする。

課題を解決するための手段

本発明の音声データ記録再生装置は、 n ビットA/D変換器と、量子化ビット数 n ビットの音声データの夫々を上位 m ビット (ただし、 m は2以上の整数で $m < n$) と下位 $(n - m)$ ビットとに分離するデータ分離回路と、トラックの第1の領域に上記上位 m ビットの各データを記録し、第2の領域に上記下位 $(n - m)$ ビットの各データを記録する記録手段とを記録系に具備し、再生手段と、上記第1、第2の各領域の再生データを結合して量子化ビット数 n ビットの音声データを得る動作を行なうデータ結合回路と、 n ビットD/A変換器とを再生系に具備するよう構成したものである。

作用

A/D変換器より取り出された量子化ビット数 n ビットの音声データ夫々はデータ分離回路により上位 m ビットと下位 $(n - m)$ ビットとに分離

され、記録手段により前者は磁気テープ上順次に形成されるトラックの第1の領域に、また後者と識別情報は同じトラックの別の第2の領域に夫々記録される。

ここで、上記第1の領域は既存の音声データ記録再生装置により量子化ビット数 m ビットの音声データが記録される領域であり、また上記第2の領域はサブコード信号が記録される領域である。

上記の記録手段により磁気テープ上に記録された信号は再生手段により再生され、再生識別情報に基づき、第1の領域の再生データと第2の領域の再生データとを結合するように動作するデータ結合回路により量子化ビット数 n ビットの音声データとされる。この量子化ビット数 n ビットの音声データはD/A変換器でアナログ音声信号に変換される。

また、上記の記録手段により磁気テープ上に記録された信号を前記既存の音声データ記録再生装置で再生した場合は、前記第1の領域から支障なく上位 m ビットの各データが音声データとして再

生され、D/A変換される。

実施例

第1図は本発明の一実施例のブロック系統図を示す。図中、入力端子10に入来した2チャンネルのアナログ音声信号は低域フィルタ(LPF)11により折り返し成分となるような不要高周波成分を除去された後、18ビットA/D変換器12に供給され、ここで標本化周波数48kHzで標本化後、量子化ビット数18ビット(すなわち $n=18$)に量子化された音声データに変換される。

この音声データはデータ分離回路13に供給され、ここでその上位16ビット(すなわち $m=16$)と下位2ビットとに分離される。上位16ビットの各データは既存のDATの音声データと同様の音声データとして符号化回路14に供給される。一方、上記下位2ビットの各データは既存のDATのサブコードデータとして符号化回路14に供給される。

また、既存のDATにおいてサブコード領域に

記録されるサブコード信号(例えばアブソリュート・タイム、プログラムタイムなどのサブデータ)は、PCM領域にオプションコードとして記録されるAC(オグジュアリ・コード)やSC(サーチ・コード)に記録されるべく、中央処理装置15より符号化回路14へ供給される。また、中央処理装置15からは下位2ビットデータをサブコード領域に記録することを示す識別情報も符号化回路14に供給される。

符号化回路14は上記の各入力データに対して夫々1フレーム(これは2トラック記録時間で、30ms)で完結するインターリーブや誤り訂正符号(パリティ)の付加などを行ない、前記上位16ビットの各データ及びサブデータを第4図に示した信号フォーマットで1ブロック単位で出力し、また前記下位2ビットの各データを第5図に示した信号フォーマット中、サブコードデータの代りに上記下位2ビットの各データが配置された信号フォーマットで1ブロック単位で出力する。

ここで、上記の下位2ビットの各データは1フ

レーム時間当り全部で720バイト($=48\text{kHz} \times 2\text{チャンネル} \times 2\text{ビット} \times 30\text{ms}$)ある。これに対し、既存のDATにより規定されているサブコード領域3a、3bに記録される全データは、1フレーム期間(2トラック)では896バイト($= (32+24)\text{バイト} \times (16/2)\text{ブロック} \times 2\text{トラック}$)で、上記720バイトより大である。

また既存のDATで規定されているバックフォーマットの場合は1バックは8バイトからなり、また2ブロック当り8バック記録され、そのうち1バックはすべてパリティであり、かつ、1バック中の1バイトはパリティである。従って、バックフォーマットの場合、1フレームの全データは784バイト($= 7\text{バック} \times 7\text{バイト} \times (16/2)\text{ブロック} \times 2\text{トラック}$)で、上記720バイトより大である。

従って、上記の下位2ビットの各データはサブコード領域にバックフォーマット又はその他のフォーマットで容量に余裕をもって記録される。

なお、前記識別情報は第5図に示したコードS

W1の下位4ビットのデータIDの値が、現在はオール“0”がオーディオ用であることが規定されているだけなので、このデータIDとしてオール“0”以外の所定の値で記録される。

符号化回路14より所定の信号フォーマットで順次に取り出されたデータは復調回路16に供給され、ここで再生周波数帯域を決くし、波形等化を行ない易くするために、8-10変調されて8ビットのデータが10ビットに変換されて出力され、更に所定の経路を経て回転ヘッドに供給され、磁気テープ上に第3図に示すトラックを順次に形成して記録される。

ただし、本実施例では第3図のPCM領域5に前記上位16ビットの各データとサブデータが記録され、サブコード領域3a、3bに前記下位2ビットの各データと前記識別情報とが夫々記録される。また、第1図では省略したが、ATF信号は既存のDATと全く同様に記録される。

ここで、サブコード領域3a、3bに記録される前記下位2ビットの各データをバックフォーマ

ットで記録する場合は、下位2ビットの各データは第2図に示す如きフォーマットで記録される。同図中、PC1~PC8により1つのバックが構成されており、その8バイト目PC8はすべてパリティからなる。また、バックの1バイト目PC1から7バイト目PC7には、第2図に示す如くインターリーブされた下位2ビットの各データが配置される(ここでは1つのチャンネルのみ)。なお、第2図中、rは下位2ビットのデータであることを示し、また数字は1フレーム中の音声データの順番を示す。

次に、本実施例の再生系の動作について説明する。記録済磁気テープから回転ヘッドにより再生されたディジタル信号は、所定の公知の信号処理回路を経て第1図の復調回路17に供給され、10ビットの各データがもとの8ビットに復調されると共に、デインターリーブが行なわれた後、復号化回路18に供給されて誤り検出、誤り訂正などが行なわれる。

復号化回路18により復号された各データ中、

前記PCM領域5に相当する記録領域から再生された、前記上位16ビットの各データはデータ結合回路19に供給され、一方、前記サブコード領域3a、3bに相当する記録領域から再生された前記下位2ビットの各データ、前記識別情報その他が中央処理装置15に供給される。また、前記PCM領域5に相当する記録領域から再生されたデータ中、第4図の同期信号の直後の2バイトW1、W2に相当する信号及び前記オプションコードエリアの信号は夫々予め決められたデータ伝送順序で再生されるから、自動的に中央処理装置15へ供給される。更に誤り検出結果により得られたエラーフラグも中央処理装置15へ供給される。

中央処理装置15は前記識別情報が入力される時はそのときに入力される前記下位2ビットのデータをそのままスルーでデータ結合回路19に供給し、ここで復号化回路18よりの前記上位16ビットのデータの下位側に結合して18ビットのデータを生成させる。この18ビットのデー

タはもとの量子化ビット数18ビットの音声データであり、18ビットD/A変換器20に供給されてアナログ信号に変換された後、低域フィルタ(LPF)21により不要高周波成分を除去されて出力端子22へ出力される。

これにより、既存のDATに比べてより量子化ノイズの少ない高品質の再生音声信号を得ることができる。

また、前記オプションコードエリアから再生されたサブデータを中央処理装置15が解読して所定の信号を所定の回路や機構へ送出することにより、既存のDATと同様のサーチやアブソリュートタイム、プログラムナンバーの表示なども行なえる。

なお、中央処理装置15は前記下位2ビットのデータがエラーと判定したエラーフラグが入力される時は、データ結合回路19へ下位2ビットとして予め設定した固定値(例えば“10”又は“01”)を供給する。この固定値を“10”又は“01”としたのは、もとの正しい下位2ビッ

トの値が“00”、“11”のどちらであっても差を小さくするためである。

一方、前記上位16ビットのデータがエラーと判定したエラーフラグが入力されるときは、中央処理装置15は下位2ビットがエラーであるかなにかに拘らず、前後の正しい18ビット再生データに基づく補間動作をデータ結合回路19で行なわせる。これにより、補間処理された18ビットの音声データが18ビットD/A変換器20へ出力される。

ところで、以上は本実施例の記録系により記録されたデータを再生した場合の動作であるが、この再生系により既存のDATで記録されたデータを再生する場合は、前記識別情報が存在しないので、中央処理装置15は自ら生成した固定の2ビット“10”(又は“01”など)を下位2ビットとしてデータ結合回路19に供給し、ここで復号化回路18より取り出された量子化ビット数16ビットの再生音声データの下位側に結合させる。

とによって既存のDATによる記録データも何の支障もなく再生できると共に、本発明による記録データも既存のDATにより従来と同程度の音質で再生することができ、互換再生を確保することができる等の長を有するものである。

4. 図面の簡単な説明

第1図は本発明の一実施例のブロック系統図、第2図は本発明により下位2ビットの記録フォーマットの一例を示す図、第3図はDATによる記録トラック及びそのフォーマットを示す図、第4図は第3図のPCM領域の記録信号フォーマットを示す図、第5図は第3図のサブコード領域の記録信号フォーマットを示す図である。

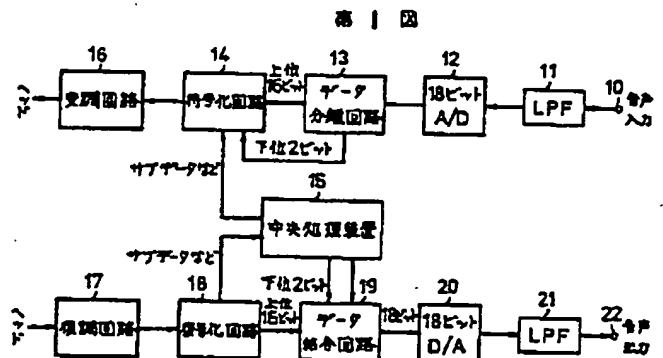
12…18ビットA/D変換器、13…データ分離回路、14…符号化回路、15…中央処理装置、18…復号化回路、19…データ結合回路、20…18ビットD/A変換器。

これにより、データ結合回路19からは全体として量子化ビット数が18ビットに拡大された再生音声データが取り出されて18ビットD/A変換器20に供給される。従って、本実施例によれば、既存のDATにより記録された記録済磁気テープも支障なく再生することができる。

一方、本実施例により記録された記録済磁気テープを既存のDATで再生した場合は、上位16ビットの各データがPCM音声データとして再生されると共に、前記識別情報によりサブコード領域からの再生信号が既存のDAT規格で定められた正規のものでないと検出されてそのサブコード領域再生信号が無視されることから、既存のDATと同程度の量子化ビット数16ビットの音質で再生され、互換再生を確保できる。

発明の効果

上述の如く、本発明によれば、既存のDATのもっている機能を劣化させることなく、それよりもより量子化ノイズが低減された高品質の再生音声信号を得ることができ、また識別情報が無いこ

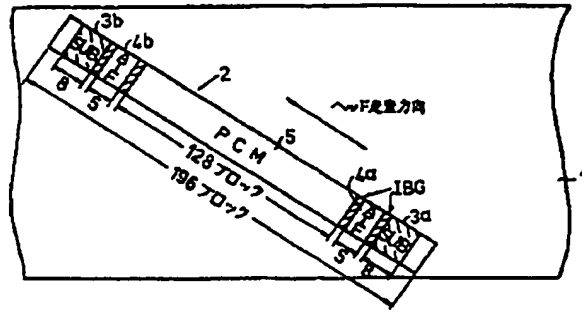


第2図

	2ビット	2ビット	2ビット	2ビット
PC 1	φ r	52r	104r	156r
2	208r	260r	312r	364r
3	416r	468r	520r	572r
4	624r	676r	728r	780r
5	832r	884r	936r	988r
6	1040r	1092r	1144r	1196r
7	1248r	1300r	1352r	1404r
PC 8	パリティ			
	8ビット			

第 3 図

テープ走査方向



第 4 図

同期 信号	W1	W2	パリティ	PCM符号率データ・パリティ
8ビット	8ビット	8ビット	8ビット	256ビット (= 32シンボル)
1ブロック、288ビット				

第 5 図

同期 信号	SW1	SW2	パリティ	サブコードデータ・パリティ
8ビット	8ビット	8ビット	8ビット	256ビット
1ブロック、288ビット				

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